

# First record of the genus *Camptotheca* (Nyssaceae) in Vietnam and the lectotypification of *C. acuminata*

Zhen-Hua Zhu<sup>1</sup>, Ngoc Bon Trinh<sup>2</sup>, Thanh Son Hoang<sup>2</sup>, Bo Li<sup>1,3</sup>

<sup>1</sup> College of Agronomy, Jiangxi Agricultural University, Nanchang 330045, China

<sup>2</sup> Silviculture Research Institute, Vietnamese Academy of Forest Sciences, Hanoi 10000, Vietnam

<sup>3</sup> Center for Integrative Conservation Biology, Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences, Mengla 666303, Yunnan, China

Corresponding author: Bo Li (hanbolijx@163.com)

## Abstract

As a primary source of anticancer camptothecin, *Camptotheca* (Nyssaceae) is an economically valuable genus and has long been recorded as endemic to China. Here, *Camptotheca* is reported as a new record to the flora of Vietnam with the discovery of a wild population of *C. acuminata* from Lai Chau Province of northern Vietnam. Based on the consultation of relevant literature and type specimens of *C. acuminata*, a lectotype of the species is designated. Photographic illustrations, morphological description and a distribution map of *C. acuminata* is provided, and a key to all known species of Nyssaceae in Vietnam is presented, too.

**Key words:** *Camptotheca*, lectotype, Northern Vietnam, Nyssaceae

## Introduction

Nyssaceae is a small angiosperm family phylogenetically placed in the order Cornales (Angiosperm Phylogeny Group 2016). It has been reduced to be a subfamily (namely Nyssoideae) of Cornaceae (Angiosperm Phylogeny Group 2009; Reveal and Chase 2011) or divided into three separated smaller families (Mastixiaceae, Davidiaceae, and Nyssaceae) (Thomas et al. 2021). Within Cornales, the phylogenetic position of Nyssaceae has been controversial. It was supported to be a sister of either Curtisiaceae in the analysis of nuclear genomes (Zhang et al. 2020), a clade comprised of Grubbiaceae and Curtisiaceae using an Angiosperms353 dataset (Thomas et al. 2021), or another clade formed by Hydrostachyaceae, Hydrangeaceae, and Loasaceae in chloroplast phylogenies (Schenk and Hufford 2010; Fu et al. 2019; Li et al. 2021). As currently circumscribed, five genera are recognized in Nyssaceae, viz., *Mastixia* Blume, *Davidia* Baill., *Nyssa* L., *Diplopanax* Hand.-Mazz., and *Camptotheca* Decne (Stevens 2001 onwards).

Within Nyssaceae, *Camptotheca* is a distinct genus and could be readily distinguished from other genera by its samaralike fruits clustered in a globose head (Qin and Chamlong 2007). In previous molecular phylogenetic analyses, a sister relationship between *Camptotheca* and *Nyssa* was solidly supported no matter using nuclear or plastid data (Xiang et al. 2011; Chen et al. 2016; Fu et al. 2017, 2019; Li et al. 2019, 2021; Thomas et al. 2021). *Camptotheca* has long been recorded as an endemic genus of seed plants in China (Fang et al. 1983;



Academic editor: Hugo de Boer

Received: 25 September 2023

Accepted: 31 October 2023

Published: 15 November 2023

**Citation:** Zhu Z-H, Trinh NB, Hoang TS, Li B (2023) First record of the genus *Camptotheca* (Nyssaceae) in Vietnam and the lectotypification of *C. acuminata*. PhytoKeys 235: 129–136. <https://doi.org/10.3897/phytokeys.235.113267>

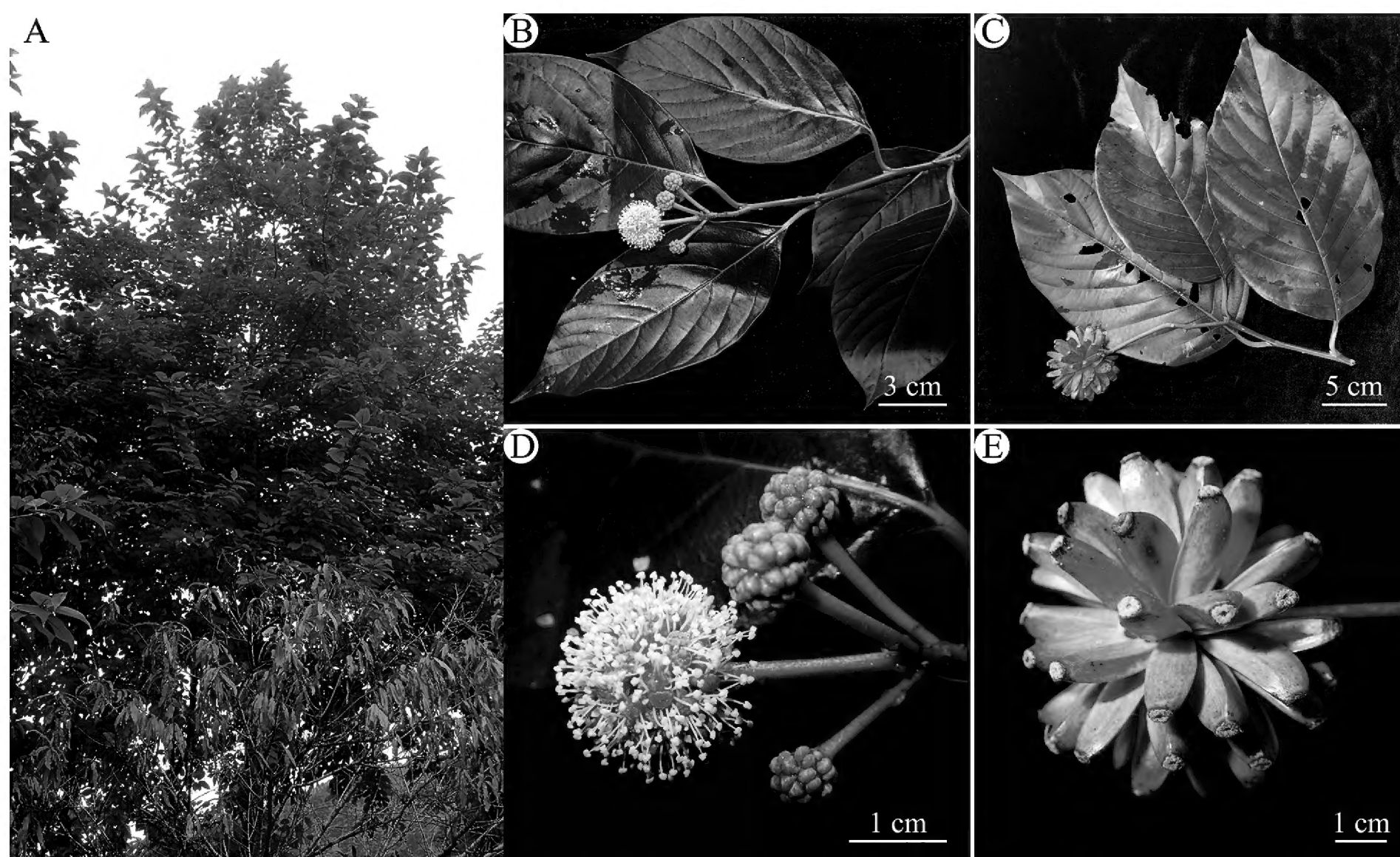
Copyright: © Zhen-Hua Zhu et al.

This is an open access article distributed under terms of the Creative Commons Attribution License (Attribution 4.0 International – CC BY 4.0).

Ying and Zhang 1994; Qin and Chamlong 2007). Since the publication of the type species, *C. acuminata* Decne., four additional taxa have been described in the genus, viz., *C. acuminata* var. *tenuifolia* W.P. Fang & Soong, *C. acuminata* var. *rotundifolia* B.M. Yang & L.D. Duan, *C. yunnanensis* Dode, and *C. lowreyana* S.Y. Li. However, the first three names have been treated as synonyms of *C. acuminata*. As currently recognized in Flora of China (Qin and Chamlong 2007), the two species, *C. acuminata* and *C. lowreyana*, can be distinguished by the shapes and number of lateral veins of leaves (Li 1997; Qin and Chamlong 2007).

*Camptotheca* is an ecologically and economically important genus, which do not only play a great role in landscaping (Zhang et al. 2004; Yang et al. 2012; Du 2013) but also is one of the most valuable woody medicine resources (Feng et al. 2000; Li et al. 2002). Ever since a special alkaloid, camptothecin, was successfully isolated from *C. acuminata* (Wall 1966), many studies have focused on its powerful anticancer effects (Venditto and Simanek 2010; Martino et al. 2017; Wang et al. 2023), and related drugs have been developed and approved for treating various cancers (Khaiwa et al. 2021; Jiao et al. 2023). Because of its great value and potential uses, *C. acuminata* was included in the List of National Key Protected Wild Plants of China (National Forestry Administration 1999).

In 2022, we encountered a small population of unknown trees without flowers and fruits in Phong Tho District of Lai Chau Province, northern Vietnam. When revisiting the locality from May to July 2023, we successfully collected flowering and fruiting specimens of this tree. After the consultation of relevant literature (Li 1997; Qin and Chamlong 2007) and comparison of type as well as other herbarium specimens, we confidently confirmed its identity as *C. acuminata* based on its morphology (Fig. 1), which appears to be the first record of the species and the genus *Camptotheca* for the flora of Vietnam.



**Figure 1.** *Camptotheca acuminata* **A** habitat and habit **B** flowering branch **C** fruiting branch **D** inflorescences **E** fruits.

## Materials and methods

Field surveys were carried out in northern Vietnam from 2022 and 2023. Voucher specimens of *Camptotheca acuminata* were collected from Phong Tho District, Lai Chau Province, and deposited in the herbarium of the Vietnamese Academy of Forest Sciences (VAFS).

High-resolution images of the type materials of *C. acuminata* held at the Muséum National d'Histoire Naturelle (P, acronyms according to Thiers 2023+) and the herbarium of Royal Botanic Gardens, Kew (K) were examined via the JSTOR Global Plants website (<https://plants.jstor.org/>). Other herbarium specimens (mainly from CAF, GXMI, HITBC, IBK, IBSC, KUN, NAS, and PE) were consulted via the Chinese Virtual Herbarium platform (<https://www.cvh.ac.cn/index.php>). The distribution map is prepared using data obtained from herbaria records as well as our field observations.

## Taxonomic treatment

***Camptotheca acuminata* Decaisne Bull. Soc. Bot. France. 20: 157 (1873).**

**Lectotype.** (designated here):—CHINA. Kiang-si (Jiangxi Province): Vallée du Ly-Chan (Lushan Mountain), 1868, A. David 866 (lectotype P00545522! [image available at <http://coldb.mnhn.fr/catalognumber/mnhn/p/p00545522>]; isoelectotypes: K000704811! [image available at <https://plants.jstor.org/stable/10.5555/al.ap.specimen.k000704811>] P00545523! [image available at <http://coldb.mnhn.fr/catalognumber/mnhn/p/p00545523>], P00545524! [image available at <http://coldb.mnhn.fr/catalognumber/mnhn/p/p00545524>], P00545525! [image available at <http://coldb.mnhn.fr/catalognumber/mnhn/p/p00545525>]).

**Description.** Trees deciduous, to 20 m high; bark light gray, deeply furrowed; young branchlets cylindrical, purplish, with gray pubescence, villous; old branchlets glabrous, sparse round or oval lenticels. Leaves alternative; petiole 1.5–3 cm, flat or slightly grooved above, round below, puberulent when young, and almost glabrous mature, blackish when dry; leaf blade papery, 12–28 × 6–12 cm, oblong-ovate, oblong-elliptic or orbicular, base subrounded, margin entire, apex acute, slightly pubescent and pale green adaxially, greenish and lucid abaxially; pinnate veins both surfaces sparsely pubescent, midrib prominent both surfaces, lateral veins (4–)8–11(–15) pairs, slightly prominent adaxially or slightly prominent only near base abaxially. Inflorescence head, terminal or axillary, 1.5–2 in diam.; peduncle 4–6 cm, cylindrical, puberulent when young, then glabrous. Flowers polygamous; bracts 3, triangular, 2.5–3 mm, both surfaces pubescent; calyx cup-shaped, shallowly 5 lobed; lobes toothed; petals 5, caducous, light green, ca. 2 mm; disk conspicuous; stamens 10, outer 5 longer than, glabrous; filaments slender; anthers tetradymous; style ca. 4 mm, glabrous; stigmas 2. Fruit thinly winged, clustered in a globose head, green when young, yellowish brown after drying, 2.5–3.5 cm × 5–7 mm. Seed 1. Cotyledons lanceolate, 2–4 × ca. 1 cm, pinniveined, with 6–8 lateral veins on each side.

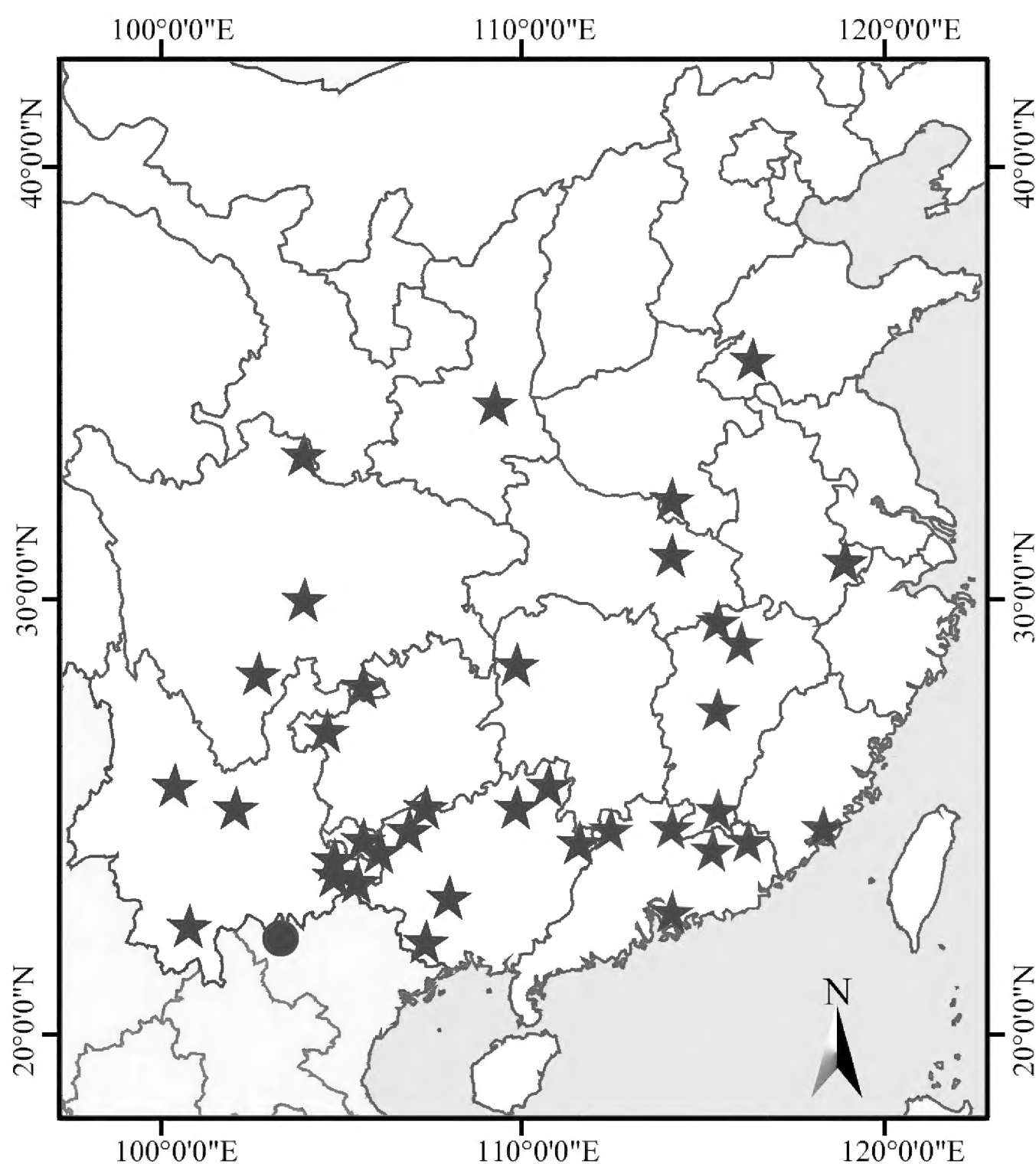
**Illustrations.** Fang and Su (1981: 316, fig. 120: 1–7); Yu (1993: 277, fig. 4: 351); Li (1997: 351–352, fig. 1–2); Wu et al. (2007: 322, fig. 322: 1–3).

**Phenology.** Flower: May–July, fruit: September.



**Distribution and habitat.** *Camptotheca acuminata* is widely distributed in southern China provinces (Fujian, Guangdong, Guangxi, Guizhou, Hubei, Hunan, Jiangsu, Jiangxi, Sichuan, Yunnan, Zhejiang), and always grows near riverbanks and forest margins below alt. 1000 m. The newly discovered population of *C. acuminata* is located in northern Vietnam and near the China-Vietnam borders (Fig. 2).

**Additional specimens examined.** CHINA, Fujian Province: Xiamen City, Siming District, Wanshi Botanical Garden, roadside, elev. 56 m, 24°27'20.2"N, 118°5'38.1"E, 24 June 2020, fr. *T.Wang* 402 (AU!); Hubei Province: Xiaogan City, Dawu County, elev. 445 m, 31°43'5.8"N, 114°19'8.9"E, 03 Nov. 2020, fr. *C. Dai* DC78 (HIB!); Sichuan Province: Leshan City, E'bian Yi Autonomous County, roadsides under forests, elev. 961 m, 29°18'53"N, 103°16'56"E, 25 Nov. 2017, fr. *X.J.Li* LiXJ830 (KUN!); Anhui Province: Xuancheng City, Jingde County, Hui River Protection Area, riversides, elev. 169 m, 30°22'37.2"N, 118°22'55.2"E, 18 Oct. 2016, fr. *W.Zhang* and *H.F.Wang* ANUB02040 (ANUB!); Guizhou Province: Bijie City, Zhijin County, Qimo Town, Sanjiashan Village, broadleaf forests, elev. 1324 m, 26°41'55.2"N, 105°46'58.4"E, 07 Aug. 2015, fr. *L.Chen* 522425150807009LY (GZTM!); Jiangxi Province: Ganzhou City, Xinfeng County, Jinpen Mountain, valley, elev. 375 m, 25°13'32"N, 115°12'44"E, 03 Oct. 2014, fr. *R.P.Kuang* LXP03-04734 (HNNU!); Hunan Province: Xiangxi Autonomous Prefecture, Baojing County, Fuxing Town, elev. 397 m, 28°38'53.9"N, 109°44'58.6"E, 12 Aug. 2012, fr. *X.J.*



**Figure 2.** Distribution of *Camptotheca acuminata* in China (green stars) and Vietnam (blue circle).

*Su and H.B.Liu 433125D00090811017* (JIU!). Vietnam. Lai Chau Province: Phong Tho District, Pa Ve Su commune, Mu Sang, Vang Ma Chai, in forests, elev. 1150 m, 22°39'38.48"N, 103°15'29.56"E, 11 June 2023, fr. *T.S.Hoang 22039* (VAFS).

**Note.** In the protologue of *Camptotheca acuminata*, Decaisne (1873) noted its type locality as “Thibet orientale, prov. Moupin, Ly-chan valley” which was proved to be erroneous according to the examination of David’s original collection labels (Franchet 1884). In fact, the type gathering (*A.David 866*) was collected by Father Armand David in 1868 from Lushan Mountain of Jiangxi Province, eastern China (Franchet 1884). When tracing the gathering, we sorted out four separate specimens held at the Muséum National d’Histoire Naturelle (P) and one deposited in the herbarium of Royal Botanic Gardens, Kew (K), and confirmed that not a single specimen has been designated as the type. Thus, we here propose the best preserved one simultaneously having flowers and fruits (barcode no. P00545522) as the lectotype of *C. acuminata* in accordance with the Article 9.3 of the International Code of Nomenclature for algae, fungi, and plants (Shenzhen Code) (Turland et al. 2018).

In Vietnam, only one genus of Nyssaceae was previously recorded, i.e., *Nyssa* L. As currently known, five species of the genus have been discovered in the country (Fang et al. 1983; Qin and Chamlong 2007; Tan and Deng 2016; Tagane et al. 2020), viz., *Nyssa javanica* (Blume) Wangerin, *Nyssa sinensis* Oliv., *Nyssa bifida* Craib, *Nyssa bidoupensis* Tagane & Yahara and *Nyssa hongiaoensis* Tagane & Komada. With the supplement of *Camptotheca* and *C. acuminata* to the Vietnamese flora, the Nyssaceae is now represented by two genera and six species. Thus, a key to all species of Nyssaceae in Vietnam is provided below.

### Key to the genera and species of Nyssaceae in Vietnam

- 1 Fruit thinly winged, clustered in a globose head ... ***Camptotheca* (*C. acuminata*)**
- Fruit drupaceous, laterally flattened, solitary or several in a cluster .... **2 (*Nyssa*)**
- 2 Trees evergreen ..... ***N. hongiaoensis***
- Trees deciduous ..... **3**
- 3 Flowers pedicellate, in umbels or racemes ..... ***N. sinensis***
- Flowers sessile or male ones shortly pedicellate, in capitates ..... **4**
- 4 Branchlets glabrous ..... ***N. bidoupensis***
- Branchlets densely tomentose ..... **5**
- 5 Branches and leaves glabrescent to subglabrous when mature ..... ***N. javanica***
- Branches and leaves persistently densely tomentose ..... ***N. bifida***

### Acknowledgements

The authors are grateful to the keepers of CAF, GXMI, HITBC, IBK, IBSC, K, KUN, NAS, P, and PE for their assistance during specimens’ examination and to Dr. Shuai Liao (South China Botanical Garden, the Chinese Academy of Sciences) for sharing relevant taxonomic literature.

### Additional information

#### Conflict of interest

The authors have declared that no competing interests exist.

## Ethical statement

No ethical statement was reported.

## Funding

This work was supported by the National Natural Science Foundation of China (grant no. 32160047).

## Author contributions

Data curation: ZHZ. Funding acquisition: BL. Investigation: TSTH, NBT, ZHZ. Resources: TSTH, NBT. Supervision: BL. Validation: BL. Writing - original draft: ZHZ. Writing - review and editing: BL.

## Author ORCIDs

Zhen-Hua Zhu  <https://orcid.org/0000-0003-1351-0942>

Ngoc Bon Trinh  <https://orcid.org/0000-0001-7530-8008>

Thanh Son Hoang  <https://orcid.org/0000-0003-0351-929X>

Bo Li  <https://orcid.org/0000-0003-1628-8128>

## Data availability

All of the data that support the findings of this study are available in the main text.

## References

- Angiosperm Phylogeny Group (2009) An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG III. *Botanical Journal of the Linnean Society* 161(2): 105–121. <https://doi.org/10.1111/j.1095-8339.2009.00996.x>
- Angiosperm Phylogeny Group (2016) An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG IV. *Botanical Journal of the Linnean Society* 181(1): 1–20. <https://doi.org/10.1111/boj.12385>
- Chen ZD, Yang T, Lin L, Lu LM, Li HL, Sun M, Liu B, Chen M, Niu YT, Ye JF, Cao ZY, Liu HM, Wang XM, Wang W, Zhang JB, Meng Z, Cao W, Li JH, Wu SD, Zhao HL, Liu ZJ, Du ZY, Wang QF, Guo J, Tan XX, Su JX, Zhang LJ, Yang LL, Liao YY, Li MH, Zhang GQ, Chung SW, Zhang J, Xiang KL, Li RQ, Soltis DE, Soltis PS, Zhou SL, Ran JH, Wang XQ, Jin XH, Chen YS, Gao TG, Li JH, Zhang SZ, Lu AM, China Phylogeny Consortium (2016) Tree of life for the genera of Chinese vascular plants. *Journal of Systematics and Evolution* 54(4): 277–306. <https://doi.org/10.1111/jse.12219>
- Decaisne MJ (1873) Caractères et descriptions de trois genres nouveaux de plantes recueillies en Chine par M. L'Abbé A. David. *Bulletin de la Société Botanique de France* 20(5): 155–160. <https://doi.org/10.1080/00378941.1873.10825497>
- Du YY (2013) A analysis on community characteristics and benefits comparison of urban landscape woods in Hefei City. Anhui Agricultural University, Hefei, 58 pp.
- Fang WP, Su HY (1981) Nyssaceae. In: Fang WP (Ed.) *Flora Sichuanica*. (Spermatophyta), Tumes. 1. Sichuan Propel'S Publishing House, Chengdu, 312–316.
- Fang WP, Soong TP, Su HY (1983) Nyssaceae. In: Fang WP, Chang CY (Eds) *Flora Reipublicae Popularis Sinicae*. Vol. 52 (2). Science Press, Beijing, 144–159.
- Feng JC, Zhang YJ, Tan YD, Zhang WJ (2000) The development in research on *Camptotheca acuminata* and utilization of camptothecin. *Linye Kexue* 36(5): 100–108.
- Franchet MA (1884) *Plantae Davidianae ex Sinarum imperio*. G. Masson Editeur, Paris, 514 pp.

- Fu CN, Li HT, Milne R, Zhang T, Ma PF, Yang J, Li DZ, Gao LM (2017) Comparative analysis of plastid genomes from fourteen Cornales species: Inferences for phylogenetic relationships and genome evolution. *BMC Genomics* 18(1): 956. <https://doi.org/10.1186/s12864-017-4319-9>
- Fu CN, Mo ZQ, Yang JB, Ge XJ, Li DZ, Xiang QY, Gao LM (2019) Plastid phylogenomics and biogeographic analysis support a trans-Tethyan origin and rapid early radiation of Cornales in the Mid-Cretaceous. *Molecular Phylogenetics and Evolution* 140: 106601. <https://doi.org/10.1016/j.ympev.2019.106601>
- Jiao XY, Lei JD, Zhu LY, Zhu HT, Zhang ZC, He J (2023) Research progress in polyethylene glycol chemical modification drugs of camptothecin and its derivatives. *Chemistry* 86(7): 843–852.
- Khaiwa N, Maarouf NR, Darwish MH, Alhamad DWM, Sebastian A, Hamad M, Omar HA, Orive G, Al-Tel T (2021) Camptothecin's journey from discovery to WHO essential medicine: Fifty years of promise. *European Journal of Medicinal Chemistry* 223: 113639. <https://doi.org/10.1016/j.ejmech.2021.113639>
- Li SY (1997) *Camptotheca lowreyana* a new species of anti-cancer happytrees. *Bulletin of Botanical Research* 17(3): 348–353.
- Li SY, Yi YZ, Wang YZ, Zhang ZZ, Beasley RS (2002) Camptothecin accumulation and variations in camptotheca. *Planta Medica* 68(11): 1010–1016. <https://doi.org/10.1055/s-2002-35652>
- Li HT, Yi TS, Gao LM, Ma PF, Zhang T, Yang JH, Gitzendanner MA, Fritsch PW, Cai J, Luo Y, Wang H, van der Bank M, Zhang S-D, Wang Q-F, Wang J, Zhang Z-R, Fu C-N, Yang J, Hollingsworth PM, Chase MW, Soltis DE, Soltis PS, Li D-Z (2019) Origin of angiosperms and the puzzle of the Jurassic Gap. *Nature Plants* 5(5): 461–470. <https://doi.org/10.1038/s41477-019-0421-0>
- Li HT, Luo Y, Gan L, Ma PF, Gao LM, Yang JB, Cai J, Gitzendanner MA, Fritsch PW, Zhang T, Jin JJ, Zeng CX, Wang H, Yu WB, Zhang R, van der Bank M, Olmstead RG, Hollingsworth PM, Chase MW, Soltis DE, Soltis PS, Yi T-S, Li D-Z (2021) Plastid phylogenomic insights into relationships of all flowering plant families. *BMC Biology* 19(1): 232. <https://doi.org/10.1186/s12915-021-01166-2>
- Martino E, Della Volpe S, Terribile E, Benetti E, Sakaj M, Centamore A, Sala A, Collina S (2017) The long story of camptothecin: From traditional medicine to drugs. *Bio-organic & Medicinal Chemistry Letters* 27(4): 701–707. <https://doi.org/10.1016/j.bmcl.2016.12.085>
- National Forestry Administration (1999) List of National Key Protected Wild Plants. Version 1999.8. [https://www.gov.cn/gongbao/content/2000/content\\_60072.htm](https://www.gov.cn/gongbao/content/2000/content_60072.htm) [Accessed 28 August 2023]
- Qin H, Chamlong P (2007) Nyssaceae. In: Wu CY, Peter HR (Eds) *Flora of China*. Vol. 13. Science Press, Beijing & Missouri Botanical Garden Press, St. Louis, 300–303.
- Reveal JL, Chase MW (2011) APGIII: Bibliographical information and synonymy of Magnoliidae. *Phytotaxa* 19(1): 71–134. <https://doi.org/10.11646/phytotaxa.19.1.4>
- Schenk JJ, Hufford L (2010) Effects of substitution models on divergence time estimates: Simulations and an empirical study of model uncertainty using Cornales. *Systematic Botany* 35(3): 578–592. <https://doi.org/10.1600/036364410792495809>
- Stevens PF (2001 onwards) Angiosperm phylogeny website, Version 14, July 2017 [and more or less continuously updated since]. <http://www.mobot.org/MOBOT/research/APweb/> [Accessed 19 October 2023]
- Tagane S, Ngoc NV, Binh HT, Nagahama A, Zhang M, Cuong TQ, Son LV, Dang VS, Toyama H, Komada N, Nagamasu H, Yahara T (2020) Fifteen new species of angiosperms



- from Bidoup-Nui Ba National Park, Southern Highlands of Vietnam. *Acta Phytotaxonomica et Geobotanica* 71(3): 201–229.
- Tan YH, Deng YF (2016) The identity of *Nyssa yunnanensis* (Cornaceae). *Phytotaxa* 252(4): 293–297. <https://doi.org/10.11646/phytotaxa.252.4.7>
- Thiers B (2023) Index Herbariorum: A global directory of public herbaria and associated staff. New York Botanical Garden's Virtual Herbarium. <http://sweetgum.nybg.org/ih/> [Accessed 1 July 2023]
- Thomas SK, Liu X, Du ZY, Dong YB, Cummings A, Pokorny L, Xiang QY, Leebens-Mack JH (2021) Comprehending Cornales: Phylogenetic reconstruction of the order using the Angiosperms353 probe set. *American Journal of Botany* 108(7): 1112–1121. <https://doi.org/10.1002/ajb2.1696>
- Turland NJ, Wiersema JH, Barrie FR, Greuter W, Hawksworth DL, Herendeen PS, Knapp S, Kusber WH, Li DZ, Marhold K, May TW, McNeill J, Monro AM, Prado J, Price MJ, Smith GF (2018) International Code of Nomenclature for algae, fungi, and plants (Shenzhen Code) adopted by the Nineteenth International Botanical Congress Shenzhen, China, July 2017. *Regnum Vegetabile* 159. Glashütten: Koeltz Botanical Books. <https://doi.org/10.12705/Code.2018>
- Venditto VJ, Simanek EE (2010) Cancer therapies utilizing the camptothecins: A review of the in vivo literature. *Molecular Pharmaceutics* 7(2): 307–349. <https://doi.org/10.1021/mp900243b>
- Wall ME (1966) Tree extract acts against cancer. *Journal of the American Medical Association* 197(10): 45. <https://doi.org/10.1001/jama.1966.03110100025009>
- Wang XZ, Zhuang YM, Wang YK, Jiang MK, Yao L (2023) The recent developments of camptothecin and its derivatives as potential anti-tumor agents. *European Journal of Medicinal Chemistry* 260: 115710. <https://doi.org/10.1016/j.ejmech.2023.115710>
- Wu ZY, Peter HR, Hong DY (2007) *Camptotheca*. In: Wu ZY, Peter HR (Eds) *Flora of China Illustrations. Clusiaceae through Araliaceae*, Vol. 13. Science Press, Beijing & Missouri Botanical Garden Press, St. Louis, 322 pp.
- Xiang QY, Thomas DT, Xiang QP (2011) Resolving and dating the phylogeny of Cornales - effects of taxon sampling, data partitions and fossil calibrations. *Molecular Phylogenetics and Evolution* 50(1): 123–138. <https://doi.org/10.1016/j.ympev.2011.01.016>
- Yang D, Wan FX, Gu TH, Li M (2012) Study on the selection of afforestation species for coastal protective in Shanghai city. *Journal of Nanjing Forestry University* 36(2): 95–100.
- Ying JS, Zhang YL (1994) Endemic genera of Chinese spermatophyte. Science Press, Beijing, 466 pp.
- Yu LL (1993) Nyssaceae. In: Qiu BL (Ed.) *Flora of Zhejiang. Aquifoliaceae through Cornaceae*, Vol. 4. Zhejiang Science and Technology Press, Zhejiang, 276–278.
- Zhang XQ, Tang JQ, Yi Y (2004) Exploitation and strategy of *Camptotheca acuminata* resource for sustainable development in China. *Journal of Guizhou Normal University* 22(1): 36–39.
- Zhang CF, Zhang TK, Luebert F, Xiang YZ, Huang CH, Hu Y, Rees M, Frohlich MW, Qi J, Weigend M, Ma H (2020) Asterid phylogenomics/phylotranscriptomics uncover morphological evolutionary histories and support phylogenetic placement for numerous whole genome duplications. *Molecular Biology and Evolution* 37(11): 3188–3210. <https://doi.org/10.1093/molbev/msaa160>